
ALMERA TRAINING WORKSHOP ON ENVIRONMENTAL SAMPLING FOR RADIONUCLIDE ANALYSES (EVT2504181), SWITZERLAND

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INTRODUCTION

The ALMERA Training Workshop on Environmental Sampling for Radionuclide Analyses (EVT2504181) was held from 1 to 5 June 2026 at the Federal Training Centre Schwarzenburg (FTCS) and Spiez Laboratory, Switzerland. The workshop was organised by the International Atomic Energy Agency (IAEA) under the Analytical Laboratories for the Measurement of Environmental Radioactivity (ALMERA) network in collaboration with Spiez Laboratory, Switzerland.

The programme brought together participants from ALMERA member laboratories representing various countries to strengthen competencies in environmental sampling for radionuclide analyses. Through lectures, practical exercises, group discussions and field activities, participants gained practical knowledge of representative sampling and its importance in supporting reliable environmental radioactivity measurements.



Figure 1. Group photo of participants and facilitators of the *ALMERA Sampling Workshop*.

REPRESENTATIVE SAMPLING AS THE FOUNDATION OF RELIABLE RESULTS

One of the key lessons from the workshop was that reliable analytical results depend on collecting representative samples. While laboratories often focus on the accuracy of measurements, the workshop highlighted those errors introduced during sampling can have a greater impact on the final result than the analytical process itself.

To address this issue, participants were introduced to the Theory of Sampling (TOS), developed by Pierre Gy. The concept explains how sampling errors can occur and provides guidance on how to minimise them. The training emphasised that even when laboratory measurements are accurate, the results may still be misleading if the samples collected do not adequately represent the area or population being studied.

The workshop also introduced the concept of Data Quality Objectives (DQO), a systematic approach for planning sampling activities. Participants learned that before any sampling campaign begins, it is important to define the purpose of the study, identify the Decision Unit (DU) to be evaluated and

determine the level of confidence required for decision-making. This approach helps ensure that sampling plans are fit for purpose and meet the requirements of quality management systems such as ISO/IEC 17025.



Figure 2. Group discussion on environmental sampling design using TOS and DQO.

FIELD EXERCISES AND GLOBAL ESTIMATION ERROR

The workshop included several field exercises based on simulated radionuclide contamination scenarios. Participants were divided into international teams and asked to develop sampling plans for hypothetical contaminated sites.

During the exercises, participants identified the Decision Unit (DU), designed sampling grids and determined the number of samples needed to obtain representative results. The activities demonstrated how environmental variability can influence sampling outcomes and data quality.

Participants were also introduced to the concept of Global Estimation Error (GEE), which considers uncertainties arising from both sampling and laboratory analysis. Through group discussions and practical exercises, participants evaluated whether the collected data were sufficient to support decision-making with the required level of confidence.

A key lesson from the exercise was that accurate laboratory measurements alone are not enough to ensure reliable results. Proper sampling design is equally important in obtaining representative data for environmental radioactivity monitoring.



Figure 3. Group members participating in a field sampling exercise.

SUBSAMPLING AND SAMPLE REPRESENTATIVENESS

Another important component of the workshop focused on subsampling techniques and their role in ensuring reliable analytical results. Participants were introduced to practical methods for reducing the size of bulk samples while maintaining their representativeness.

Through hands-on exercises involving sample mixing, homogenisation and sample division, participants learned how improper subsampling can introduce bias and affect the quality of analytical results. The training highlighted that obtaining a representative field sample is only the first step; proper sample preparation is equally important to ensure that the portion analysed in the laboratory accurately reflects the original sample.

The session also demonstrated how subsampling errors contribute to overall measurement uncertainty and emphasised the importance of applying appropriate sample preparation procedures, particularly for heterogeneous matrices such as soil and sediment.



Figure 4. Practical exercise on sample mixing, homogenisation and subsampling techniques.

WATER SAMPLING AND ENVIRONMENTAL MONITORING

The workshop also included sessions dedicated to water sampling strategies and the challenges associated with obtaining representative samples from aquatic environments. Participants were introduced to approaches for defining Decision Units within rivers and water bodies, selecting representative sampling locations and understanding the influence of environmental variability on analytical results.

The discussions highlighted the importance of integrating field observations, sampling objectives and statistical considerations when designing monitoring programmes. These concepts are directly applicable to environmental radioactivity monitoring activities involving surface water, groundwater and marine environments.



Figure 5. Demonstration of water sampling techniques during the *Water Sampling* module.

TECHNICAL VISIT TO SPIEZ LABORATORY

A major highlight of the workshop was a technical visit to Spiez Laboratory, one of Switzerland's leading institutions in environmental radioactivity monitoring, radiological protection, nuclear forensics and CBRN (Chemical, Biological, Radiological and Nuclear) preparedness.

Participants also gained insight into the role of Spiez Laboratory in supporting radiological preparedness, environmental monitoring and international technical cooperation. The visit provided valuable insight into how environmental sampling, laboratory measurements and scientific interpretation are integrated within a national radiological protection framework.

INTERNATIONAL NETWORKING AND KNOWLEDGE EXCHANGE

Beyond the technical sessions, the workshop provided valuable opportunities for professional networking and knowledge exchange among participants from ALMERA member laboratories worldwide. Informal discussions during group activities and social events enabled participants to share experiences related to radionuclide analyses, quality assurance practices and emergency preparedness programmes implemented in their respective countries.

These interactions fostered stronger professional relationships within the ALMERA network and created opportunities for future technical collaboration, exchange of expertise and participation in international capacity-building initiatives coordinated by the IAEA.



Figure 6. Networking dinner with participants and experts from ALMERA member laboratories.

RELEVANCE TO MALAYSIA

The knowledge and experience gained from the workshop are directly applicable to environmental sampling activities conducted by the Malaysian Nuclear Agency, particularly those involving soil, sediment, water and biota monitoring programmes.

The training also provided exposure to international best practices that can support ongoing efforts to strengthen sampling protocols, improve data quality and enhance compliance with ISO/IEC 17025 requirements. Furthermore, participation in the workshop expanded professional networks with ALMERA member laboratories and international experts, creating opportunities for future technical collaboration and knowledge exchange in the field of environmental radioactivity monitoring.

CONCLUSION

The ALMERA Training Workshop on Environmental Sampling for Radionuclide Analyses (EVT2504181) provided valuable exposure to the principles and practices of environmental sampling for radionuclide investigations. The workshop reinforced the importance of systematic sampling design, uncertainty management and fit-for-purpose data collection in supporting reliable radionuclide analyses and informed

decision-making.

The knowledge acquired during the programme will support ongoing efforts by the Malaysian Nuclear Agency to strengthen environmental radioactivity monitoring activities and enhance compliance with international best practices and ISO/IEC 17025 requirements.